

MINERALOGY AND OXYGEN ISOTOPE COMPOSITIONS OF TWO C-RICH HYDRATED INTERPLANETARY DUST PARTICLES.

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Introduction: Oxygen isotopic compositions of chondrites reflect mixing between a ¹⁶O-rich reservoir and a ¹⁷O,¹⁸O-rich reservoir produced via mass-independent fractionation. The composition of the ¹⁶O-rich reservoir is reasonably well constrained [1], but material representing the ¹⁷O,¹⁸O-rich end-member is rare [2]. Self-shielding models [3] predict that cometary water, presumed to represent this reservoir, should be enriched in ¹⁷O and ¹⁸O by > 200‰. Hydrated interplanetary dust particles (IDPs) rich in carbonaceous matter may be derived from comets [4]; such particles likely contain the products of reaction between ¹⁶O-poor water and anhydrous silicates that formed in the inner solar system. Here we present mineralogy and oxygen isotope compositions of two C-rich hydrated IDPs, L2083E47 and L2071E35.

Analytical Conditions: The IDPs were embedded in elemental sulfur and thin sections (~50 nm thick) were prepared by ultramicrotomy for mineralogical, chemical and isotopic analysis by using transmission electron microscopy (TEM) and NanoSIMS at JSC. The remainder of each IDP was extracted from the S and pressed into a high-purity Au for bulk electron microprobe analyses and isotopic analyses. Oxygen isotopes were measured on the UCLA Cameca ims-1270 ion microprobe using a 10KeV, 3nA Cs+ primary beam and a 10µm spot. A mass resolution >9000 was used to resolve the ¹⁷O and the ¹⁶OH peaks. ¹⁶O was measured on a Faraday cup, and ¹⁷O and ¹⁸O were measured on electron multipliers. San Carlos olivine, Burma spinel, and Afrique magnetite were used to define the TF line, and Afrique magnetite was used to correct for instrumental mass fractionation.

Results and Discussion: The mineralogy of E47 is dominated by amorphous Si-rich material, poorly crystalline saponite, magnetite and fine-grained FeNi sulfide grains. The magnetite is confined to a single framboidal aggregate. E47 is C-rich (~16 wt.% C) and contains abundant nanoglobules. E35 was strongly heated during atmospheric entry as evidenced by a continuous magnetite rim. The phyllosilicates in E35 have been converted to amorphous Si-rich material and Fe-oxides, while the carbonate grains have been altered to fine-grained Mg-Fe oxides. The bulk C content of E35 is ~8 wt.%.

Oxygen isotope compositions for E35 and E47 were measured in three repeat analyses per particle. The average oxygen isotope composition of E35 was $\delta^{18}\text{O} = +11.8\text{‰} \pm 3.5\text{‰}$, $\delta^{17}\text{O} = +13.1\text{‰} \pm 1.00\text{‰}$. The average oxygen isotope composition of E47 was $\delta^{18}\text{O} = +2.79\text{‰} \pm 3.6\text{‰}$, $\delta^{17}\text{O} = 3.56\text{‰} \pm 7.5\text{‰}$. Compositions of both particles fall on a slope 1 line above the terrestrial fractionation line, as predicted for interaction with cometary heavy water.

References:

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